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VIII.

Illustrations of Fossil Footprints of the Valley of the Connecticut.

By JAMES DEANE, M. D.

(Communicated to the Academy, August 8th, 1849.)

THE beautiful footprints upon the sandstone strata of Connecticut River were discovered in the year 1835. They indicate the existence of vertebrated, air-breathing, and warm-blooded animals at a remote period of the earth's geological antiquity; comprising at least two classes of the animal kingdom, *Aves* and *Reptilia*.

The number and perfection of these remarkable relics, the huge size of many of the creatures by whom they were impressed, and the consideration of the remote epoch in which they lived, invest the subject with intense interest. To myself, their study has for many years been in the highest degree attractive, and my labors in the field have invariably been compensated by successful discovery. As a result of the investigation, I respectfully offer this brief memoir. I have no intention of entering fully into the subject; my plan is merely to present some obvious practical views, grounded upon facts, leaving purely speculative conclusions out of the question. I do not even attempt a classification of the footprints. The creatures that made them existed in immense numbers, and unquestionably belonged to numerous families, genera, and species; yet to distinguish them all by strict rules of classification is absolutely impracticable. The forms of the footprints are extremely diversified, even in unblemished impressions, and glide into each other by insensible gradations. But insurmountable obstacles are presented in the various conditions of the stratum at the time the animal walked over it, and in the changes which the tracks must have, in many cases, subsequently undergone. If the surface whereon the creature trod was consolidated by desiccation, a superficial flattened impress resulted; if yet too soft, the impression must have closed in; and between these extreme conditions there are infinite modifications of form. I apprehend that another difficulty in the way of classification arises from the fact, that the footprints

were impressed by individuals in all stages of development, from the young to the perfect animal.

In many localities, as at Wethersfield in Connecticut, the footprints, being impressed upon soft and yielding clay, are ruined by subsequent changes; while at others, as at Turner's Falls, they occur without blemish. So imperfect are the footprints at most localities, that it was not until the year 1843, when my attention was attracted to those at Turner's Falls, that examples occurred sufficiently perfect to exhibit the phalangeal, ungual, and dermoid systems of the toes. Impressions which do not display these essential features are more or less imperfect. In a considerable proportion of the footprints, no doubt, the evidence is so unquestionable, that we cannot hesitate in deciding upon specific characters; yet to embrace the whole, or even the greater part of them, in any system of classification upon principles of true science, is, in my opinion, impossible. We cannot, with any thing like certainty, restore the anatomical organization of the animals by whom the footprints were impressed; and until this can be done, any system of nomenclature must be both artificial and arbitrary. The presumption is, that the animals resorted to the ancient shores for subsistence and reproduction. From the impressions of their feet we may infer that they were small or great, that they were or were not rapacious, that they were light or heavy, that they were elevated upon long or short legs, and that they were analogous to certain living types; but beyond this we can hardly go. We cannot determine their individual habits or distinctive organization, which are indispensable conditions of specific classification. I therefore neither adopt nor attempt any detailed methodical arrangement; which can, at best, be little more than an arbitrary invention, tending in no degree to advance our knowledge, but rather to involve a most simple subject in inextricable confusion. In a remote era of the earth's history, certain tribes of animals roved upon the soft margins of seas or lakes, and there imprinted their footsteps. The stratum thus impressed was subsequently overspread by a new layer of plastic clay, which was trodden upon in turn, and the impressions preserved by a newer deposit. Page after page of the vast volume of the earth's annals was thus sealed up, to be opened, after the lapse of unnumbered centuries, to our admiring eyes.

Unfortunately, no osseous remains of the animals themselves have ever been discovered. The argillaceous quality of the rock was doubtless unfavorable to their preservation; yet we might still expect that osseous *impressions* would occur. Perhaps the thin hollow shell that forms the bones of most birds, permeable by air, would cause the carcass to be floated away in the periodical overflow of the waters, supposing the birds to have perished upon the narrow shores whereon they congregated. It is only upon localities which were periodically submerged that we find footprints; it must be

here, only, that the fossil skeleton will be found. Such a discovery would supply the legitimate elements of specific distinctions. Nevertheless, we can unquestionably determine the classes to which the authors of the footprints belonged by the principles of reciprocal relation. The foot of a tridactylous bird has three phalangeal bones for the inner toe, four for the middle, and five for the outer ones; but the impression of the terminal joint is that of the nail only. Consequently, the inner toe has two, the middle three, and the outer four distinct lobate expansions, corresponding to the respective joints. Now, it is this immutable law that connects the extinct with living birds. That such impressions are due to birds is proved by a principle nearly as infallible as that supplied by osseous structure. Taken in connection with the accompanying phenomena, such as the alternation of the feet, and the impression of the ungual and tegumentary tissues, in both living and fossil races, the grounds of analogy are simple and unimpeachable.

The ancient birds were mostly tridactylous; many, however, have a fourth toe pointing backward. Some were no larger than small living birds; but in general, the impressions indicate animals vastly larger than their living representatives. Quadrupeds co-existed with the birds, and their impressions often occur upon the same stratum. These animals were diminutive, and doubtless belonged to several families of Batrachian reptiles.

The country of the extinct animals was extensive. Commencing near the northern boundary of Massachusetts, it stretches away southerly through the State into Connecticut, and reappears in New Jersey and in Pennsylvania. But the ancient sandstone basin is of limited breadth in all places. It is bounded upon either hand by primitive formations, and through the western margins of the sandstone beds a basaltic dyke has been ejected, the protrusion of which has disturbed the position of the sedimentary beds, and afforded the opportunity to investigate their contents. The localities where footprints have been observed are very numerous. In general, they are abundantly found wherever extensive explorations have been conducted in the stratified portion of the sandstone. The localities that furnish the most numerous, and beyond all comparison the most beautiful specimens, are those at Turner's Falls, the northern terminus of the sandstone beds. The models for the plates are derived from this source; whence I have obtained slabs containing as many as seventy-five impressions.

With these preliminary remarks, I proceed to illustrate these footprints by presenting copies, selected from the most perfect and beautiful examples. The drawings were put upon the stone by myself, with the utmost care, and I have attempted to compensate for the lack of artistic execution by producing faithful transcripts of the originals. I hope that my efforts in this difficult undertaking may not prove entirely unacceptable.

PLATE I.

This is a miniature drawing of one of the finest specimens of fossil footprints ever obtained. I discovered it several years since at Turner's Falls; and it is now in the British Museum. It is about 8×6 feet in dimensions, and the drawing is reduced to one twelfth linear measure. It displays upon its surface seventy-five footprints, arranged in determinate lines. There are five rows traversing the plate from side to side, consisting of five and six tracks each. An impression from one of these rows is represented by Fig. 2, Plate IV. There is a row of fifteen impressions of a much smaller bird running upward through the left side of the plate, and a pair of them are drawn upon Plate III. Fig. 3. Another row of this variety runs across the bottom of the plate from right to left; another runs downward upon the right side; but these are imperfect, being impressed when the stratum was too soft to retain distinctly the forms: a fourth line crosses from left to right upon the upper portion of the plate. The remaining lines are impressed by a bird whose foot is drawn upon Plate IV. Fig. 1. One line of four imprints runs upward through the centre of the plate; one line of four imprints passes over the central fragment from right to left; just below is a line of two impressions passing in the same direction; and near the bottom of the plate is another row of three impressions, also passing from right to left. These several lines embrace all the footprints, and it is singular that two or more footprints nowhere fall upon the same place.

This and the next plate are given for the double purpose of representing the serial order in which the impressions to be described are arranged, and to convey a general idea of the manner in which these remarkable slabs were traversed by the ancient birds. No other specimens have ever been found of equal perfection and richness.

PLATE II.

This is also a miniature drawing of a specimen of ornithic footprints belonging to the cabinet of Mr. D. Marsh, by whom it was discovered in 1848. It is accurately reduced to one twelfth linear measure; the slab is, therefore, about 10×6 in dimensions, and contains upon its beautiful, smooth, unbroken surface more than sixty perfect impressions. It is nearly impossible to give, by a figure or description, an adequate idea of its perfection. The configuration of the several footprints appears to be identical; the only apparent difference is that of size. In this respect it is singular; for where great numbers occur upon the same stratum, as in Plate I., the aggregate usually comprises several distinct species. The probability therefore is, that this elegant group was impressed by both young and adult individuals of the same species. The larger imprints measure ten

inches in length, and the smaller three inches; and these extremes are connected by a regular gradation of size. The stride, however, of some of the lesser imprints is nearly equal to that of the larger ones; a disparity which can only be explained upon the supposition, that the animals moved with different degrees of velocity. The two larger birds walked side by side, while others moved in all directions. Each footprint upon the plate displays the phalangeal ranks of the toes, the impression of the tarsus, and that of the nail, with astonishing fidelity. To avoid confusion, I have, as in Plate I., connected the steps comprising each individual transit with a fine line. The stride is very great in all the various lines, — a fact which indicates that the birds were tall, — and a line connecting three or more footprints is nearly direct. In short-legged birds this line is more or less oblique, which is seen to be the case in the larger footprints of Plate I.

The impressions upon this plate are identical with Fig. 4, Plate III., Figs. 3 and 4, Plate IV., Figs. 1 and 2, Plate V., and Plates VI. and VII. Notwithstanding the disparity in point of magnitude in these several examples, I cannot doubt their identity. At any rate, it is impossible to tell wherein the difference consists, except in size. The peculiar characteristics of this class of impressions are very striking. The toes are exceedingly massive, are nearly parallel, and are always in contact, being separated in all instances by a fine ridge only. The impressions of each articulation, the heel and claws, are wonderfully distinct; and in all points this elegant and remarkable species is well represented by the footprints of existing struthious birds. I have in my possession, through the kindness of J. D. Bradley, Esq., of Brattleboro', a foot of the Emu, which sustains a perfect analogy to these impressions, — the broad, massive joints, the tarsus, and the long, blunt nails, showing an entire similarity.

The various imprints upon this plate will serve to convey an idea of the difficulties in the way of classification. If they are not considered to belong to the same species or family, I know of no distinctions whereby they may be separated. It is impossible to look upon this magnificent slab without feelings of astonishment. No language can be more eloquent or descriptive. If the creatures had walked upon plastic wax, the impressions could scarcely have been more perfect. To see consecutive tracks nearly one foot in length, made with a stride of four feet, surrounded by an assemblage of lesser impressions, is a spectacle calculated to fill the mind with sentiments of wonder and awe.

PLATE III.

The footprints of six distinct species of birds are delineated upon this plate, each of the natural size. They were obtained at the various localities of Turner's Falls, and are remarkable for their distinct configuration and diminutive size.

Fig. 1 is the smallest example of ornithic footprints known. It is a left foot, and displays the marks of peculiar organization tolerably well. The toes are massive; the inner one showing two lobes distinctly, and the middle and outer ones their respective number, but indistinctly: the nails are also slightly impressed. The impression of the tarsus or distal extremity of the tarso-metatarsal bone is perceptible, and, altogether, it is the best example of this most diminutive species I have seen. The step is four inches. This species is rare, and I have seen it at no other localities.

Fig. 2 is a beautiful specimen of the left and right foot of a bird, probably no larger than the preceding; but the impression differs in this respect, that the toes are more numerous and less massive. The phalangeal ranks are not very distinct; but the general features of the track are very striking. Specimens are rare; I have only seen them at a place called the Race, at the uppermost locality of fossil footprints, four miles above Turner's Falls. This example of footprints is strictly analogous to those of several families of the existing order Passerineæ.

Fig. 6 is a fine footprint, and is very rare. It was discovered by Mr. Marsh,* an enthusiastic and successful explorer of these relics, who by his sagacity and industry has accumulated a magnificent collection of footprints. The impression is deep, and the phalangeal ranks are conspicuous. The heel is singular, being as deep as the toes, and formed of two equal oval parts, each pointing obliquely outward. The first joint of the middle toe is prolonged backward to an extent so unusual as to suggest the probability of distortion. It may be remarked in this place, that the inner and outer toes in fossil examples project backward to a like extent nearly; but the outer or long one invariably a little the most. It is well to bear this fact in mind; for the outer toe, in good examples, Fig. 4, for instance, appears to project much farther backward than the inner one. This apparent difference is caused by the impression of the bilobed tarsus, one division of which is placed in continuation of the long toe, and the other falls between the first joints of the lateral toes, by the embrace of which it is in many species much modified in form. Such, however, does not happen in Fig. 3, for instance. Fig. 6 is so rare, that neither Mr. Marsh nor myself have seen it in consecutive series; but the length of the step was probably four or five inches. The bird was comparatively heavy. It will be noticed that the imprint of the nails is much distorted, which results from subsequent changes in the soft material upon which the impression is made.

Fig. 5 is drawn from a cast presented to me some years since by President Hitchcock, as was also Fig. 1, by whom both species were discovered. It is a fine, deep, regu-

* Wherever the discovery is not directly accredited to others, it has invariably been made by myself.

lar, but imperfect impression, showing neither phalangeal ranks or nails. It has the fourth toe pointing backward, as in many orders of existing birds. The rolling up of the mud anterior to the lateral toes, and a prolonged depression posterior to the heel, suggests the idea of the slipping of the foot, which often happens. The clearness and symmetry of the impress renders it very elegant; still it is but an outline impression.

Fig. 3 is a beautiful example of footprints, perfectly developed in all respects. The order of articulations, and the imprint of the tarsus and nails, are clear and unequivocal. This variety is common at Turner's Falls, but is seen at no other locality. It is shown in consecutive series upon Plate I., which contains several examples. The line of fifteen impressions, running upward through the whole length of the plate, belongs to this species. That running transversely across the upper half from left to right is another; and there is still another at the bottom of the plate, crossing from right to left. The impress is usually superficial, but always accurate. The position of the footprints *a* and *b* would seem to be irregular, but it must be remarked that the feet of birds almost invariably point inward. In reptilian quadrupeds the reverse happens, their feet uniformly pointing outward; and this is an important distinction in studying these fossils. The central toe in birds usually points to the succeeding footstep. The direction, therefore, in which Fig. 3 moves is not perpendicular to the plate, but obliquely to the right. To know where the repetition of *a* will happen, take the distance *a* and *b*, and the direction of the central toe *b*, and the proper place will be accurately given. The original slab of Plate I. was incrustated by a thin layer of micaceous sandstone, the removal of which required the laborious application of the chisel; yet so accurate was the principle, that I uncovered row after row, cutting down at once upon the footsteps only. A line, therefore, connecting these impressions runs alternately from side to side, and its obliquity depends upon the length of the leg. Thus, in Fig. 3, the zigzag direction of this line is considerable, as will be seen by reference to Plate I., while the impressions in Plate II. are almost in a direct line.

The distinctive features of this species, then, consist in the strongly marked and tapering toes, long and blunt nails, the divergence of the lateral toes, and the broad space which separates them from the central one and the tarsus, which is separated from the toes, and is placed farther backward than usual. The lateral toes with the double-headed tarsus represent the letter V correctly.

Fig. 4 is a beautiful footprint, and is the type of a series of impressions to which I shall bespeak particular attention. It belongs to that group represented by Plate II. Its peculiarity consists in its massive toes, its long and narrow impression, its graceful outline, the perfect impression of the tarsus and nails, and its great length of stride. The

divergence of the toes is so slight that they are in contact. There is a peculiarity in the long toe which I shall show in other examples, namely, there appear to be but three joints, yet it really has the requisite number; the third and fourth joints being so compressed as to form a single impression. The nails are strong and blunt, the tarsus deep and apparently joined to the outer toe, and, on the whole, the foot is analogous to that of struthioid birds. It may be noticed that the second and third joints of the central toe brushed the stratum a little distance to the right, before the foot settled permanently. As I shall have occasion again to refer to this beautiful example, I will now only say that the stride is ten inches.

PLATE IV.

The footprints upon this plate represent three distinct species of birds, and, from their magnitude and perfect impress, they are peculiarly adapted to illustrate the organic configuration of the foot. The originals were derived from Turner's Falls.

Fig. 2 is the right foot of a short-legged, heavy bird, as is known by the shortness of stride, which is fourteen inches, from the depth of the impression, and the breadth to which the feet are separated. It is common at Turner's Falls, and a few other localities, and is nearly always perfect. It is represented in consecutive series upon Plate I., the lines of large impressions running from side to side representing this species. Fig. 2 is taken from a footstep in one of these lines. The toes are very massive, distinctly separated, and the ungual appendages perfectly defined. The surface of the slab is not rough, nor yet smooth, yet the weight of the bird condensed the resisting medium to the smoothness of glass. The outer toe is relatively long and tapering, and the whole number shows the lobate divisions beautifully. In this instance, the tarsus did not descend low enough to make a distinct impression, which is usually the case in this species. The nails are blunt, long, and broad. Altogether, it is a most remarkable impression; but beyond the legitimate inference that it is referable to a heavy bird with short legs, all is hypothetical.

Connected with this species are the usual embarrassing questions concerning specific distinctions. It is the representative of a large group of similar impressions, and is the largest of the series. But, gradually descending in magnitude and extent of stride, are many impressions that sustain a close affinity to it, and the question whether they should be regarded as specifically different, or as being due to younger individuals, is difficult to decide. If all the modifications of the fossil footprints were regarded as specific, the list of species would indeed be very great.

Fig 1. A right foot, in the general appearance analogous to Fig. 2, except that it is

smaller and not quite so perfect. The impress is deep and clear, the outer toe is long and tapering, and all the toes exhibit the articulating ranks. The impress of the middle and inner toes is slightly distorted, yet the appearance of the fossil is expressive. The tarsus is slightly impressed. From its analogy to Fig. 2, it might be supposed to be the young of that species; which cannot be the case, for the stride is invariably very long. In this instance it is twenty-two inches. The line of four impressions, running upward through the centre of Plate I., was impressed by this species.

Figs. 3 and 4. These drawings represent a magnificent species of footprint, which I have selected to illustrate the probability, that certain analogous impressions, differing in magnitude, are due to an identical species, being impressed by individuals in various stages of development. The distinctive marks of organization are very striking. The foot is long, narrow, and distinctly impressed. A peculiar mark of distinction in this species is the shortness of the outer toe, projecting backward and forward little more than the inner toe. In Figs. 1 and 2, the outer toe is relatively very long; in this species, it is relatively very short. Another remarkable distinction is the circumstance, that the lateral toes embrace and modify the form of the first joint of the central toe. The lateral toes diverge less than in other species. The tarsus is invariably impressed, and its lobes and those of the respective joints are exceedingly massive. The nails are perfectly defined. Those terminating the lateral toes have an unusual divergence. The step is very long, in the figures being about two feet. The bird was doubtless of great relative magnitude, for the impress, like that of Fig. 2, is always perfect, a circumstance resulting from condensation by great pressure. The concavities of the joints are smooth, polished, and lustrous. These large and powerful birds appear to have outlived other species, for while they became extinct, or at least disappear, these are found under all circumstances. They abound at Turner's Falls, where the strata rest upon a base of igneous rock, and also at the Race, several miles distant, and at intermediate places. Figs. 3 and 4 are represented upon Plate II. in consecutive order. If the reader will turn to Fig. 4, Plate III., he will see that it bears unimpeachable analogy to the figures under consideration, and a regular gradation in point of size connects them, extending to impressions of more than one foot in length, (I have seen them of eighteen inches,) with a stride of four feet.

PLATE V.

The footsteps upon this plate are, I think, identical with those of Fig. 4, Plate III.; Figs. 3 and 4, Plate IV., being impressed by larger individuals, upon strata of different degrees of resistance. Fig. 1 is deep, while Fig. 2 is a very superficial impression. In

Fig. 1, the clay upon which the bird trod was yielding, yet not too soft to retain the form of the foot perfectly. The tarsus, phalanges, and nails are distinct. In Fig. 2, the impress is flattened by the resistance of the stratum to the weight of the bird; still, the articulations are distinct. The stratum is covered with the marks of rain-drops, but the weight of the bird obliterated them completely. I have often seen, in long rows of footprints, the phenomena presented by these two figures. The first impressions of the series would be flattened, the succeeding ones deeper, and *vice versâ*, the animal passing from one condition of the strata to the other, or from the higher parts of the shore into the water, or in the opposite direction. Fig. 2 is spread more than Fig. 1; but the difference is attributable to the different degrees of solidification of the strata. The most elegant examples of footprints are often those which are completely flattened, for they usually present a clearer definition than those which are deep.

PLATE VI.

The figure represented by this drawing is the middle toe of a footprint, fifteen inches in length, and ten in breadth between the extremities of the lateral toes. The stupendous magnitude of the extinct birds, as indicated by this fine impression, is without parallel in existing types. The area of the foot is at least four times greater than that of any living bird, and doubtless the true proportions were still more extraordinary. Colossal birds abounded in vast numbers during the sandstone era, for their vestiges are distributed over the entire extent of the sandstone basin. They are most numerous at Turner's and at South Hadley Falls.

The phalangeal divisions of this immense footprint are perfectly defined; and between it and Fig. 1, Plate III., there occurs, in the ornithic footprints of Connecticut River, a regular gradation of intermediate forms. I obtained this footprint from Turner's Falls.

PLATE VII.

Aside from its vast size, this is a beautiful and exceedingly interesting footprint, on account of the distinct impression of the heel, phalanges, and nails. The figure is taken from the specimen of Mr. Marsh, which is represented on Plate II. It holds an intermediate grade between the figures of Plates V. and VI.; and they were all, in my opinion, impressed by different individuals of the same species of bird, in various stages of growth. The remarks upon Figs. 3 and 4, Plate IV., are applicable in this instance.

PLATE VIII.

The footprints upon this plate embrace three distinct species of quadrupeds from the

quarries at Turner's Falls. They indicate animals of diminutive forms. Their peculiarity consists in the great disproportion between the hind and fore feet, in which respect they resemble some existing batrachian reptiles, lizards, salamanders, &c.

Fig. 1 was discovered by Mr. Marsh, whose cabinet contains a fine collection of this class of fossils. Figs. *a*, *b*, and *c* are consecutive impressions. The distinctive character of this species consists in each foot having four tapering, radiating toes, and in a prolonged depression backward of the tarsal bone. The fore foot is planted in advance, and a little *outward* of the hind foot, while in Fig. 2 the fore foot falls *within* the impress of the posterior member, and in Plate IX., Fig. 1, it is directly in advance. These impressions are so perfect as to show marks of the sharp claws terminating the toes. In the short stride it differs from

Fig. 2, the stride of which is nearly twice as great, although the foot is smaller. Another distinction consists in the form of the toes, which are massive, broad, and blunt, and lie in contact. I may remark here, that the position of both *a* and *b*, Fig. 2, is erroneous. Fig. 2, *a*, should point obliquely to the *left*, precisely like Fig. 4; and Fig. 2, *b*, should also be reversed. The mistake was caused in transferring the outline, and was not discovered in time to be corrected. The impressions are remarkably fine, and are derived from Mr. Marsh's museum, although I discovered this species several years ago. The fore foot is usually placed *within* the hind one; in Fig. 2, *a*, the small foot is partially obliterated by the impress of the hind one. Unlike Fig. 1, there is no prolonged depression backward from the foot; but, in place of it, the tarsal impress is perfect. There are four toes; the two outer ones of equal length nearly; the two inner ones are shorter. A line connecting *a*, *b*, *c*, Fig. 1, is abrupt; that connecting Fig. 2 is nearly direct. The animal, therefore, had very long legs, which the stride also indicates, and small feet, with exceedingly thick toes. I have seen rows of ten consecutive impressions.

Fig. 4 is strictly identical, although much larger than Fig. 2, and between them there occurs a regular gradation of size.

Fig. 3 is a remarkable example of quadrupedal imprints, and one which is difficult to understand; for, unlike the preceding figures, the impress of the fore foot appears to be wanting. It is taken from a series of seven pairs of deep impressions. Each foot has four toes pointing obliquely outward, and, unless upon the supposition that the impress of the fore foot was too slight to be retained, I cannot comprehend the movement by which the animal advanced. Mr. Marsh has a larger specimen, apparently identical, in which the same difficulty exists. In both instances, the footprint is deep and imperfect, showing that considerable change happened to the stratum subsequent to its impress; and this might suffice to obliterate a slight impression of the fore foot.

PLATE IX.

The footprints upon this plate belong to the same class as those upon Plate VIII., and in general appearance there is a striking similarity, yet they are specifically distinct. They were discovered by Mr. Marsh, at Turner's Falls, and are deposited in his cabinet.

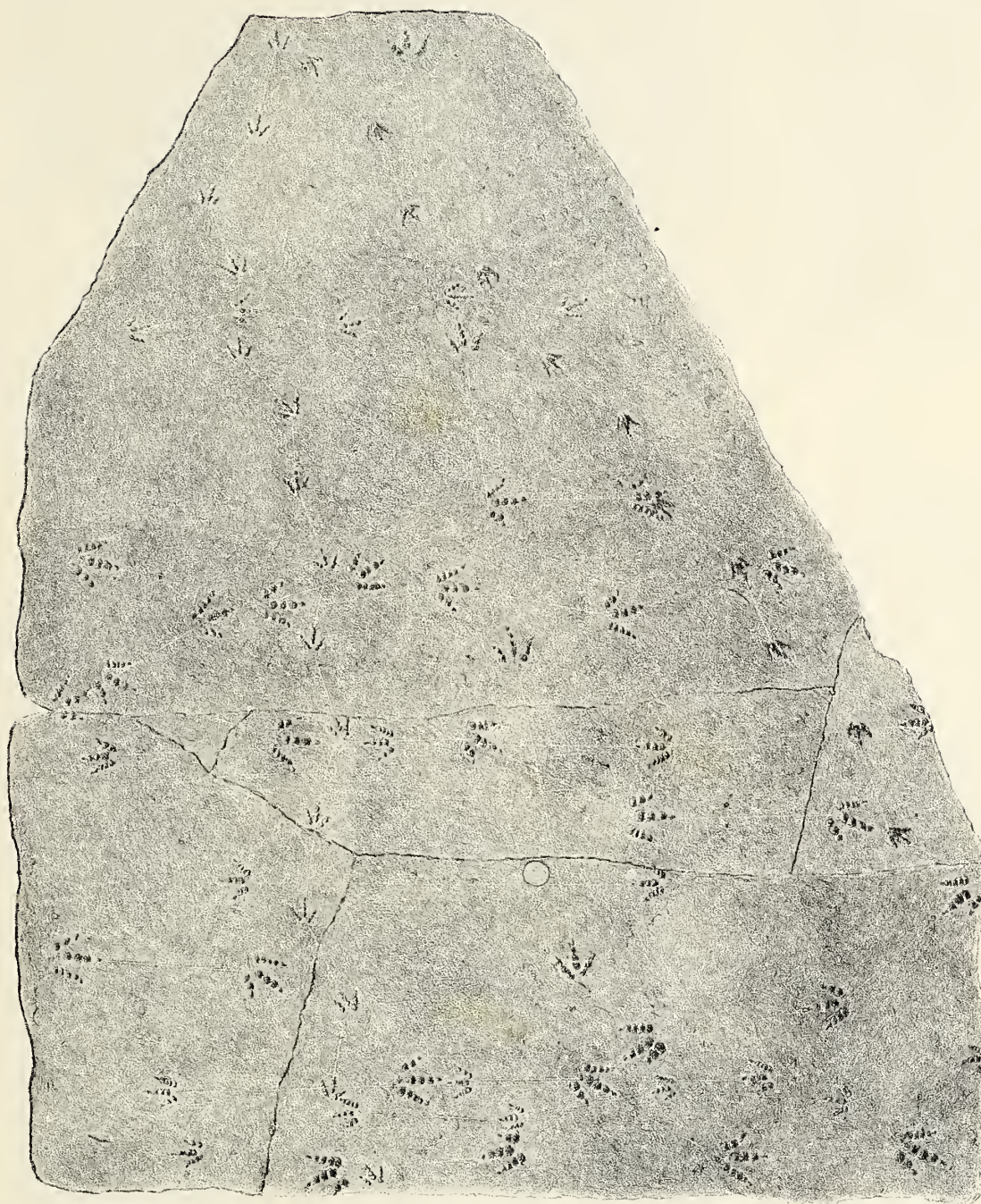
Fig. 1 has a strong affinity to Fig. 1, Plate VIII. It has the like number of toes, but their arrangement is entirely different. It has the posterior ulnar impress, in which respect there is no resemblance. Three of the toes point forward; they are long and slender, the outer one diverging considerably. The fourth toe is inserted far behind the others, and is short and pointed. The posterior depression is irregular, concave, and terminates in a deep, rounded impress, while in Fig. 1, Plate VIII., this appendage is longer, broad, and becomes superficial behind, until it disappears altogether. In Fig. 1, Plate VIII., the feet point obliquely outward; in this, obliquely inward, which is the first instance of the kind I have seen in quadrupedal imprints. The fore foot is placed directly in advance of the hind one; while in Fig. 1, Plate VIII., it is planted forward and outward; and in Fig. 2, Plate VIII., directly inward. These are unquestionably specific points of difference.

Fig. 2 represents a singular species of quadrupedal footprints, of peculiarly diminutive size; being the smallest impressions of animals ever discovered. The style of the foot is analogous to Fig. 3, Plate VIII.; that is, there is no evidence of a fore foot. Unlike it, however, the toes are long, slender, parallel, and extremely delicate. The surface of the stone is exceedingly smooth, giving great distinctness to the impressions, notwithstanding their minuteness. The delicate impress of the extremities of the toes in dragging from one step to another is well marked. How strange that a creature so insignificant should leave such clear and indelible vestiges, enduring for countless cycles of time, while the proudest efforts of intellectual man scarce survive him, and a few centuries obliterate his name, his language, and his works for ever!



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FOSSIL FOOTPRINTS OF BIRDS.



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Fig. 1.



b



Fig. 4.

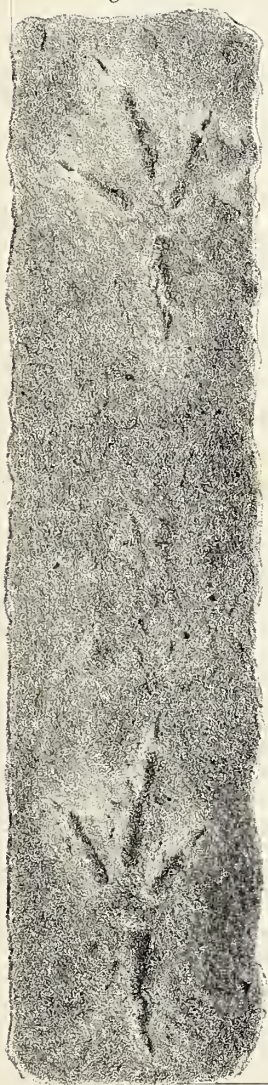
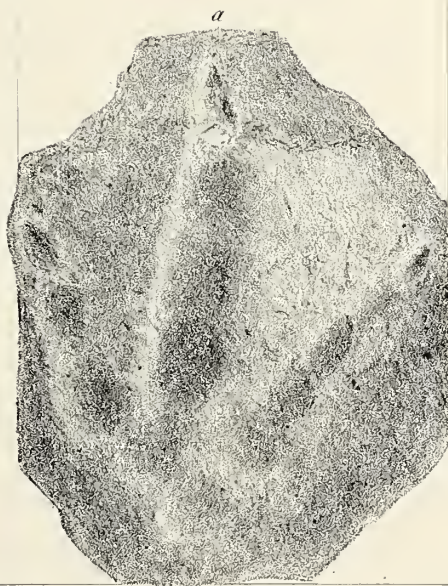


Fig. 2.

Fig. 3.



a



Fig. 5.



Fig. 6.

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Fig. 3.

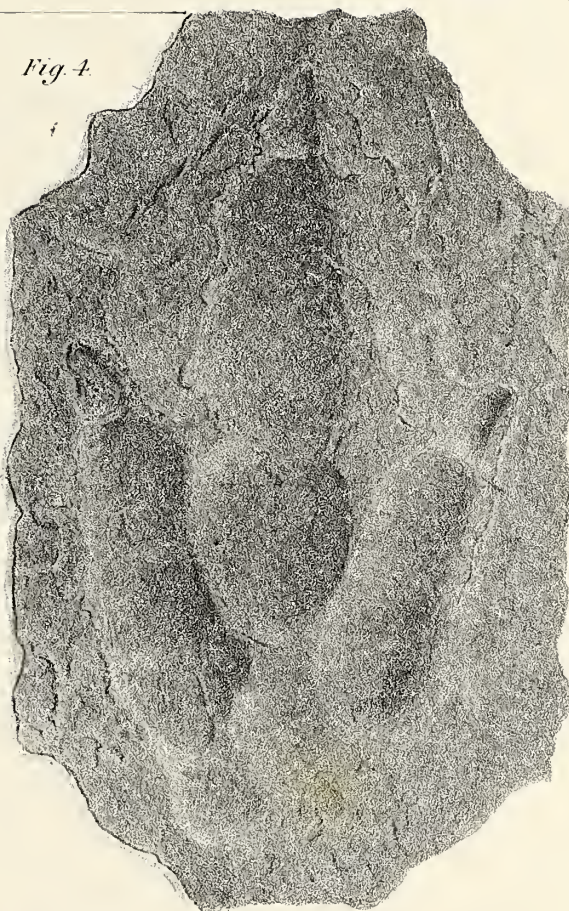


Fig. 4.

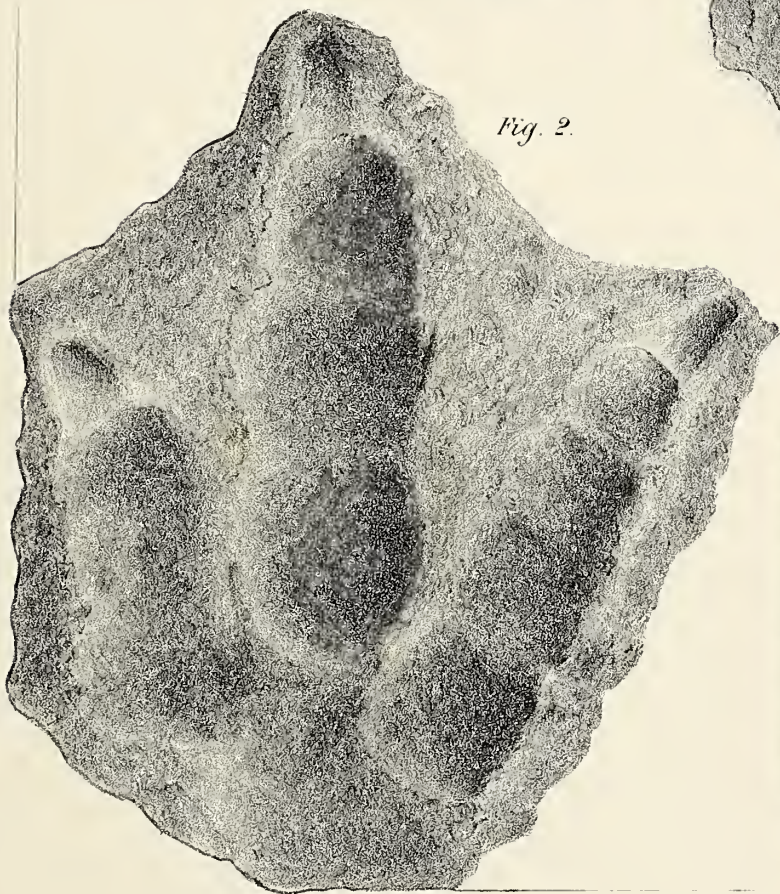


Fig. 2.



Fig. 1.

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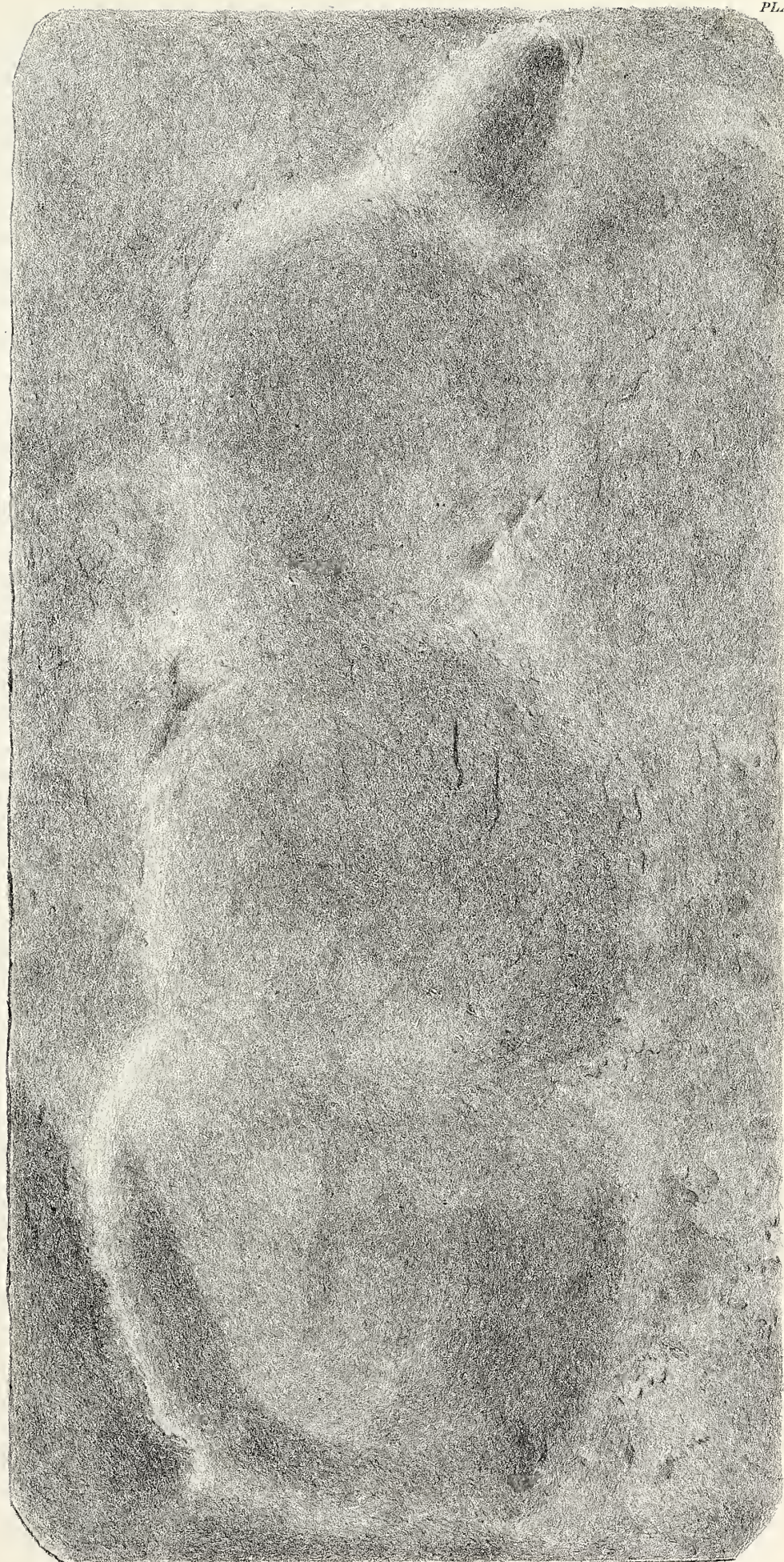
Fig. 1



Fig. 2



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Fig. 4.



Fig. 2 b



c

Fig. 3.



b

Fig. 1.

Fig. 2 a



a



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Fig. 2.

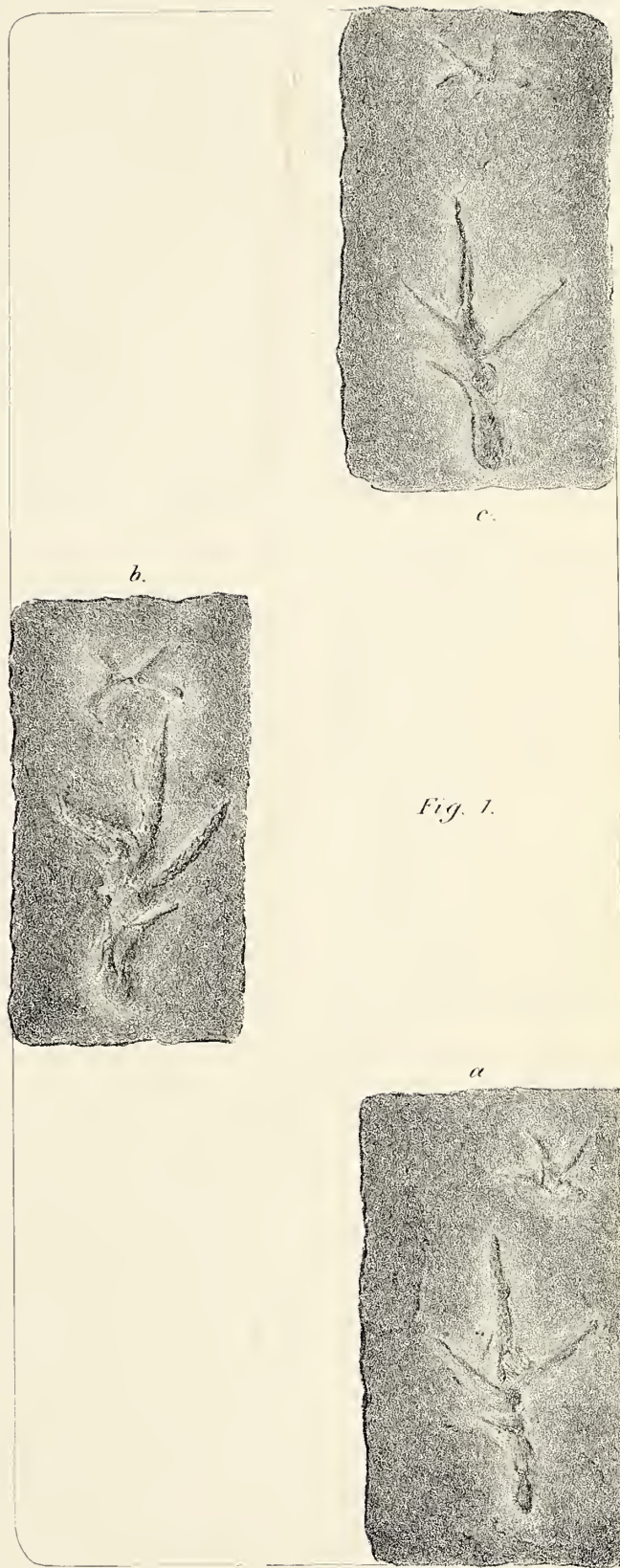
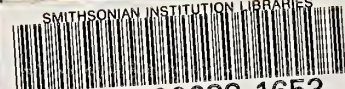


Fig. 1.

Prepared by Endicott & Co. N.Y.

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